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Type I Progress Report

December 20, 1973 - February 19, 1974

Crop Identification & Acreage

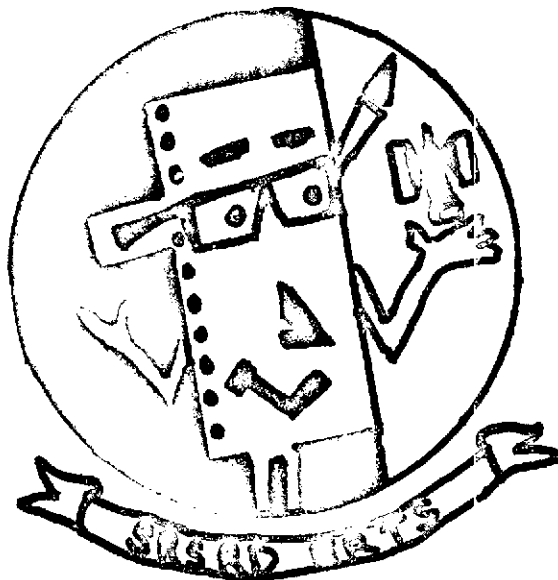
Measurement Utilizing ERTS Imagery 013

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Principle Investigator

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### Segment (Ground Truth) Location

Segment and field location for the project is nearly complete. Coordinate recording and key punching of fields, segments, and independent test areas such as counties is also nearing completion.

<u>State</u>	<u>Segment</u>	<u>Segment located</u>	<u>Segments in which fields were located</u>
Missouri	50	29	29
Idaho	62	58	57
Kansas	63	52	52
South Dakota	60	49	45

Segments and fields not found were either covered with clouds or isolated on a single tape.

It was found that locating segments and fields within and recording their coordinates was a very time-consuming task. In order for a system such as ERTS to become operational on a large scale, this is one area where automation will be necessary.

The study thus far indicates that the exact location of ground truth is one of the most important phases of the analysis. This is especially true when one is studying a large area.

A significant change can take place in the spectral response of a given crop over an ERTS frame because of differences in variety, weather, season, cultural practice, etc. These changes could render training data in one area of a frame, useless in another. Randomization or a systematic selection can yield representative ground truth over a frame.

However, the spectral response of a crop may vary a good deal over a frame, and therefore, we may need to retrain several times within a frame. Especially in frames where weather conditions and soils vary drastically.

### Ground Data

#### Field size:

Several inquiries have been received asking for size of field information. Because of this interest a detailed breakdown of number of fields and size by crop has been prepared. (See Tables 1-4).. The breakdown was based on the raw data obtained from the June Enumerative Survey for June 1972 of our four test sites. It should be pointed out that this information only represents the four areas.

In the Missouri test site, 28.7 percent of the fields are 20 acres or greater and account for 68 percent of the land area. Thirty-eight percent of the cotton fields are greater than 20 acres, but account for 73 percent of the reported cotton acreage. Forty-one percent of the soybean fields were 20 acres plus which represented 77.5 percent of the soybean acreage. The average size of all fields in Missouri was 17.11 acres.

South Dakota reported that 92 percent of the corn acreage was contained in fields larger than 20 acres and 89 percent of the oats were in fields larger than 20 acres. Overall, 52 percent of the reported fields were greater than 20 acres with an average field size of 28.74 acres. The average field size needs to be viewed with some caution in that it can be heavily influenced by large or small acreages of relatively unimportant land uses such as pasture, farmstead, etc.

Kansas showed 98.5 percent, 99.1 percent, 98.5 percent, and 95.6 percent of the corn, wheat, sorghum, and alfalfa acreage respectively, were grown in fields larger than 20 acres. Field size should not be a limiting factor in identifying these crops in Kansas. Average size of all fields was 108.31 acres.

The test area in Idaho contained some large areas of waste and pasture which influenced the average field size and the distribution. About 50 percent of the corn was planted in fields larger than 20 acres. Eighty-five percent of the barley was in 20 acre plus fields. Ninety-four percent of the potatoes were contained in fields larger than 20 acres. About 65 percent of the sugar beets were grown in 20 acre plus fields.

If field size is a factor in ones ability to do crop classification, the results in Kansas should be substantially better than in the other three states. Field shape may be a greater limiting factor than its size, particularly in areas which contain irregular fields.

#### Flight strip ground data:

An error in the computation of ground estimates for the aircraft flight strips has been discovered and we are in the process of redoing these computations. Since this is a subsample of the total area for each test site, the coefficients of variation could be quite large. However, we should still have a good check on the aerial photography results.

#### Microdensitometer

The high speed punch was installed by Dick Ulinski of Perkin-Elmer Corporation on January 13-14. While he was here, he also looked into the stage runaway problem. Two IC chips were replaced. The following week, the equipment was moved to a new location. The runaway problem has returned, but is not as bad as before.

Table 1--Distribution of number of fields by size and crop for Crop Reporting District 9, based on June Survey Data - Missouri

Crop	0-4.9 Acres				5-9.9 Acres				10-14.9 Acres				15-19.9 Acres				20-29.9 Acres				30 + Acres			
	Fields		Acres		Fields		Acres		Fields		Acres		Fields		Acres		Fields		Acres		Fields		Acres	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Farmstead, etc.	71	57.7	134.1	13.1	17	13.8	107.8	10.5	16	13.0	184.5	18.0	6	4.9	97.0	9.5	8	6.5	186.0	18.2	5	4.1	315.0	30.7
Cotton	18	14.1	59.7	2.0	21	16.4	139.0	4.8	18	14.0	211.0	7.2	22	17.2	368.5	12.8	16	12.5	384.0	13.2	33	25.8	1744.5	60.0
Corn	6	20.0	16.0	4.3	8	26.7	52.9	14.3	9	30.0	106.0	28.6	1	3.3	15.0	4.1	4	13.3	96.0	26.0	2	6.7	84.0	22.7
Oats	1	100	4.0	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barley	2	100	7.0	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Winter Wheat	4	4.6	9.7	0.6	15	17.2	106.0	6.0	25	28.7	278.6	15.8	13	15.0	212.2	12.1	16	18.4	362.5	20.6	14	16.1	789.6	44.9
Rye	3	42.9	7.5	13.8	3	42.8	22.0	40.3	-	-	-	-	-	-	-	-	1	14.3	25.0	45.9	-	-	-	-
Watermelons	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	100	35.0	100
Soybeans	30	16.3	71.2	1.7	30	16.3	204.5	4.9	28	15.2	328.3	7.9	20	10.9	334.4	8.0	32	17.4	757.9	18.2	44	23.9	2476.0	59.3
Sorghum	2	28.5	7.0	7.7	2	28.6	12.0	13.2	1	14.3	10.0	11.0	-	-	-	-	1	14.3	25.0	27.5	1	14.3	37.0	40.6
Wild Hay	-	-	-	-	1	100	8.0	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alfalfa	2	66.7	7.0	31.8	-	-	-	-	-	-	-	-	1	33.3	15.0	68.2	-	-	-	-	-	-	-	-
Other Hay	3	23.1	9.0	3.1	4	30.8	27.0	9.3	-	-	-	-	-	-	-	-	1	7.7	24.0	8.3	5	38.4	229.0	79.3
Clover	1	20.0	4.0	5.2	2	40.0	12.7	16.6	-	-	-	-	-	-	-	-	1	20.0	20.0	26.1	1	20.0	40.0	52.1
Pasture	18	28.6	56.5	4.4	11	17.5	73.2	5.8	5	7.9	58.5	4.6	7	11.1	113.3	8.9	11	17.4	248.4	19.5	11	17.5	722.6	56.8
Cropland Pasture	3	42.8	11.0	12.4	1	14.3	6.0	6.7	1	14.3	10.0	11.2	-	-	-	-	-	-	-	-	2	28.6	62.0	69.7
Other Crops	-	-	-	-	1	50.0	8.0	24.2	-	-	-	-	-	-	-	-	1	500	25.0	75.8	-	-	-	-
Soil Improvement Crops	20	47.6	41.5	14.1	13	30.9	91.4	31.1	5	11.9	55.5	18.9	1	2.4	18.8	6.4	2	4.8	47.0	15.9	1	2.4	40.0	13.6
Idle	17	25.8	50.6	7.2	19	28.8	120.2	17.1	17	25.7	196.7	28.0	5	7.6	87.8	12.5	5	7.6	102.0	14.5	3	4.5	146.0	20.7
Totals:																								
Number of fields	201				148				125				76				99				123			
Acres	495.8				990.7				1439.1				1262.0				2302.8				6720.7			
Number of fields % of total	26.0				19.2				16.2				9.9				12.8				15.9			
Acres % of total	3.8				9.5				10.9				9.6				17.4				50.9			
Average Size of field-acres	2.47				6.69				11.51				16.61				23.26				54.64			

Average Size of all fields = 17.11 acres

Table 2--Distribution of number of fields by size and crop for Crop Reporting District 6, based on June Survey Data - South Dakota

Crop	0-4.9 Acres				5-9.9 Acres				10-14.9 Acres				15-19.9 Acres				20-29.9 Acres				30 + Acres			
	Fields		Acres		Fields		Acres		Fields		Acres		Fields		Acres		Fields		Acres		Fields		Acres	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Farmstead, etc.	33	30.5	89.8	10.5	49	45.5	337.6	39.4	14	13.0	157.0	18.4	6	5.6	93.0	10.9	3	2.7	62.0	7.3	3	2.7	115.0	13.5
Corn	5	2.9	13.9	0.2	12	6.9	92.3	1.4	15	8.6	179.0	2.7	16	9.2	270.8	4.1	42	24.1	1016.3	15.5	84	48.3	5003.6	76.1
Oats	7	5.9	22.0	0.6	10	8.4	73.1	2.0	10	8.4	113.0	3.1	12	10.1	205.1	5.5	30	25.2	679.1	18.3	50	42.0	2611.8	70.5
Barley	-	-	-	-	5	26.3	39.3	7.0	1	5.3	14.0	2.5	6	31.6	95.0	17.0	-	-	-	-	7	36.8	411.0	73.5
Winter Wheat	1	33.3	2.5	6.7	-	-	-	-	1	33.3	11.0	29.3	-	-	-	-	1	33.3	24.0	64.0	-	-	-	-
Soybeans	-	-	-	-	1	8.3	8.5	3.7	2	16.7	20.0	8.6	3	25.0	53.2	22.9	5	41.7	113.0	48.5	1	8.3	38.0	16.3
Sorghum	2	25.0	8.0	3.9	-	-	-	-	-	-	-	-	1	12.5	15.0	7.3	3	37.5	63.0	30.7	2	25.0	119.0	38.1
Wild Hay	2	8.7	4.4	0.9	7	30.5	46.5	9.1	2	8.7	26.0	5.1	1	4.3	15.5	3.0	4	17.4	89.0	17.3	7	30.4	332.0	64.6
Alfalfa	6	6.5	19.2	0.9	9	9.9	61.2	2.8	20	22.0	233.2	10.7	13	14.3	211.0	9.6	23	25.3	519.0	23.7	20	22.0	1144.0	52.3
Other Hay	10	55.5	20.0	4.0	1	5.6	5.0	1.0	2	11.1	20.0	4.1	1	5.6	16.0	3.2	-	-	-	-	4	22.2	433.0	87.7
Flax	1	5.6	2.5	0.7	1	5.5	7.0	1.9	3	16.7	35.0	9.5	2	11.1	34.0	9.3	8	44.4	192.0	57.4	3	16.7	96.0	26.2
Pasture	6	6.8	14.5	0.3	4	4.6	25.5	0.5	12	13.6	128.0	2.8	3	3.4	46.0	1.0	9	10.2	220.0	4.8	84	61.4	4186.0	90.6
Cropland Pasture	5	10.4	15.5	1.1	6	12.5	41.7	3.0	9	18.8	109.4	7.8	4	8.3	69.0	4.9	10	20.8	227.5	16.3	14	29.2	935.3	66.9
Summer Fallow	8	12.7	22.5	1.3	4	6.4	27.0	1.6	7	11.1	75.0	4.4	10	15.9	171.9	10.0	13	20.6	303.5	17.7	21	33.3	1113.8	65.0
Other Crops	7	53.7	21.7	16.2	3	23.1	21.5	16.0	2	15.4	23.0	17.1	-	-	-	-	-	-	-	-	1	7.8	68.0	50.7
Soil Improvement Crops	-	-	-	-	1	8.3	8.0	2.8	1	8.3	13.0	4.5	3	25.0	49.0	16.8	5	41.7	122.0	41.9	2	16.7	98.8	34.0
Idle	6	23.1	16.2	3.5	2	7.7	16.8	3.6	3	11.5	33.0	7.1	4	15.4	65.0	14.1	6	23.1	135.2	29.3	5	19.2	196.0	42.4
Rye	-	-	-	-	1	11.1	5.0	2.6	1	11.1	11.0	5.6	2	22.2	31.0	15.9	3	33.4	77.0	39.5	2	22.2	71.0	36.4
Spring Wheat	1	16.7	1.3	0.9	1	16.6	8.0	5.7	1	16.7	10.0	7.1	-	-	-	-	-	-	-	-	3	50.0	122.0	86.3
Burn Wheat	-	-	-	-	1	50.0	6.0	22.2	-	-	-	-	-	-	-	-	1	50.0	21.0	77.8	-	-	-	-
Totals:	100						118				106				87				166				283	
Number Fields	274.0						830.0				1210.6				1440.5				3863.6				17094.3	
Acres	11.7						13.7				12.3				10.1				19.3				32.9	
No. fields % of total	1.1						3.4				4.9				5.8				15.6				69.2	
Acres % of total	2.74						7.03				11.42				15.56				23.27				60.40	

Average Size of all fields = 28.74 acres

Table 3--Distribution of number of fields by size and crop for Crop Reporting district 7, based on June Survey Data - Kansas

Crop	0-4.9 Acres				5-9.9 Acres				10-14.9 Acres				15-19.9 Acres				20-29.9 Acres				30 + Acres			
	Fields		Acres		Fields		Acres		Fields		Acres		Fields		Acres		Fields		Acres		Fields		Acres	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Farmstead, etc.	41	56.9	82.5	20.0	19	26.4	106.8	25.8	5	6.9	50.0	12.1	2	2.8	34.0	8.2	3	4.2	68.0	16.5	2	2.8	72.1	17.4
Corn	2	4.2	7.5	0.2	2	4.2	14.0	0.4	2	4.2	20.0	0.5	1	2.1	18.0	0.4	2	4.1	45.0	1.1	39	81.2	3,880.4	97.4
Oats	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	100.0	40	100.0	-	-	-	-
Barley	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	100.0	152.0	100.0
Winter Wheat	5	2.5	11.8	0.1	4	2.0	27.2	0.2	1	0.5	12.0	0.1	5	2.6	83.7	0.5	23	11.6	560.8	3.4	160	80.8	15,747.8	95.7
Rye	-	-	-	-	-	-	-	-	1	100.0	10.0	100.0	-	-	-	-	-	-	-	-	-	-	-	-
Vegetables	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	100.0	40.0	100.0
Sorghum	1	1.5	2.0	0.1	1	1.5	9.0	0.1	1	1.5	14.0	0.2	5	7.4	81.0	1.1	3	4.5	73.0	1.0	56	83.6	7,138.1	97.5
Alfalfa	1	4.3	4.0	0.2	1	4.4	7.5	0.5	2	8.7	22.0	1.4	2	8.7	34.0	2.3	2	8.7	55.0	3.5	15	65.2	1,435.7	92.1
Other Hay	2	20.0	6.0	4.3	4	40.0	26.0	18.4	-	-	-	-	-	-	-	-	2	20.0	44.0	31.2	2	20.0	65.0	46.1
Sugar Beets	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	100.0	129.0	100.0
Pasture	-	-	-	-	3	2.6	24.0	0.1	8	6.9	91.9	0.3	3	2.6	49.4	0.2	5	4.3	129.5	0.4	97	83.6	31,190.6	99.0
Cropland Pasture	1	6.2	3.9	0.4	2	12.5	13.8	1.4	2	12.6	22.6	2.3	1	6.2	17.0	1.8	-	-	-	-	10	62.5	918.0	94.1
Summer Fallow	5	2.7	15.3	0.1	3	1.6	20.7	0.1	6	3.2	64.0	0.4	10	5.3	167.2	0.9	10	5.4	241.8	1.3	153	81.8	17,798.9	97.2
Other Crops	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	100.0	60.0	100.0
Soil Improvement Crops	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	100.0	515.0	100.0
Idle	-	-	-	-	1	25.0	6.0	6.5	-	-	-	-	1	25.0	18.0	19.6	-	-	-	-	2	50.0	68.0	73.9
Totals:																								
Number of fields	58				40				28				30				52				546			
Acres	133.0				255.0				306.5				502.3				1,257.1				79,210.6			
Number of fields % of total	7.7				5.3				3.7				4.0				6.9				72.4			
Acres % of total	0.2				0.3				0.4				0.6				1.5				97.0			
Average Size of field-acres	2.3				6.4				10.9				16.7				24.2				145.1			

Average Size of all fields = 108.31 acres

Table 4--Distribution of number of fields by size and crop for the four county test areas in South Central Idaho, based on June Survey Data.

Crop	0-4.9 Acres				5-9.9 Acres				10-14.9 Acres				15-19.9 Acres				20-29.9 Acres				30 + Acres			
	Fields		Acres		Fields		Acres		Fields		Acres		Fields		Acres		Fields		Acres		Fields		Acres	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Perennial, etc.	138	55.9	303.9	1.2	46	18.6	288.1	1.1	18	7.3	213.1	0.8	5	2.0	81.0	0.3	14	5.7	333.3	1.3	26	10.5	24,708.8	95.1
Corn	6	10.9	15.1	1.7	13	23.6	95.1	10.9	11	20.0	134.7	15.4	11	20.0	190.0	20.6	9	16.4	214.8	24.5	5	9.1	235.6	26.9
Oats	1	25.0	2.2	4.2	-	-	-	-	-	-	-	-	3	75.0	50.5	95.8	-	-	-	-	-	-	-	-
Barley	6	7.6	13.8	0.5	9	11.4	70.3	2.3	10	12.7	116.9	3.7	15	19.0	253.7	8.1	11	13.9	257.1	8.2	28	35.4	2,414.1	77.2
Winter Wheat	-	-	-	-	11	29.7	78.7	5.0	8	21.6	91.5	5.9	1	2.7	17.0	1.1	4	10.8	88.7	5.7	13	35.2	1,284.3	82.3
Mixed Grain	-	-	-	-	1	5.3	8.0	0.8	8	27.6	91.9	21.1	3	10.3	53.5	12.3	1	8.5	93.0	15.0	5	10.6	216.2	34.8
Spring Wheat	5	17.2	19.3	4.4	8	27.6	51.7	11.8	9	19.2	113.7	18.3	3	6.4	50.5	8.1	1	3.5	22.0	5.0	4	13.8	198.0	45.4
Potatoes	-	-	-	-	1	5.3	8.0	0.8	2	10.5	27.6	2.8	1	5.2	18.0	1.8	1	5.3	25.0	2.6	14	73.7	905.0	92.0
Sweet Corn	2	13.3	6.5	1.3	2	13.4	12.0	2.5	3	20.0	35.1	7.3	1	6.7	16.3	3.4	2	13.3	41.7	8.7	5	33.3	367.6	76.8
Vegetables	1	100.0	1.0	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dry Beans	10	7.6	31.1	1.4	30	22.7	223.7	10.3	37	28.0	434.2	19.9	20	15.1	320.1	14.7	20	15.2	467.5	21.5	15	11.4	701.3	32.2
Dry Field Peas	3	20.0	9.9	4.1	-	-	-	-	4	26.7	49.0	20.4	4	26.6	70.5	29.3	3	20.0	77.0	32.0	1	6.7	34.0	14.2
Wild Hay	1	100.0	4.0	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alfalfa	40	15.3	132.2	2.6	68	26.0	472.0	9.4	52	19.8	621.5	12.4	34	13.0	565.5	11.3	30	11.4	729.3	14.6	38	14.5	2,486.2	49.7
Other Hay	-	-	-	-	3	60.0	21.9	31.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Clover	-	-	-	-	2	100.0	14.8	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sugar Beets	8	11.1	25.6	1.7	13	18.0	95.8	6.5	17	23.6	193.5	13.1	12	16.7	204.9	13.8	11	15.3	274.8	18.6	11	15.3	684.5	46.3
Apples	-	-	-	-	1	100.0	7.0	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pasture	70	30.8	170.4	0.1	47	20.7	299.7	0.1	19	8.4	228.1	0.1	14	6.2	223.4	0.1	17	7.5	397.7	0.1	60	26.4	455,091.6	99.5
Cropland Pasture	5	20.0	12.1	3.3	10	40.0	72.3	19.5	5	20.0	56.5	15.2	1	4.0	19.0	5.1	-	-	-	-	4	16.0	211.0	56.9
Summer Fallow	5	12.8	16.7	0.9	8	20.5	53.4	2.9	2	5.1	28.3	1.6	2	5.1	31.0	1.7	7	18.0	177.5	9.8	15	38.5	1,509.6	83.1
Other Crops	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soil Improvement Crops	3	33.3	8.0	10.1	4	44.5	28.9	36.4	1	11.1	11.0	13.9	-	-	-	-	-	-	-	-	1	11.1	31.4	39.6
Idle Cropland	21	51.2	61.0	13.9	14	34.2	93.7	21.4	2	4.9	26.5	6.1	1	2.4	15.0	3.4	-	-	-	-	3	7.3	241.6	55.2
Totals:																								
Number of fields	335				306				208				133				133				248			
Acres	865.1				2,102.4				2,473.1				2,202.5				3,199.4				491,355.8			
Number of fields % of total	24.5				22.4				15.2				9.7				9.7				18.2			
Acres % of total	0.2				0.4				0.5				0.5				0.6				97.8			
Average size of field-acres	2.6				6.9				11.9				16.6				24.1				1,973.3			

Average Size of all fields = 367.91 acres



We have added special grounding to the y axis encoder and to the J30 and J31 signed jacks to help control any static electricity that could be a problem, but this has not helped. We are in the process of trying to eliminate possible causes.

We are going to check the encoder scales for possible misalignment as a result of the move, and monitor the power line for voltage fluctuations.

#### Data Analysis

Results of the analysis for this progress period have been in the form of locating segments and punching cards for training data. We are planning to begin analysis for Kansas and South Dakota the first week in March.

Also, the Idaho tape (1035-17525) that had banding problems was reprocessed at Goddard and is now ready to be reformatted for analysis. Our preliminary investigation should be completed for all four test areas shortly. We plan to do some detailed work in the Idaho test site.